

Drinking Water Laws & Rules and Water Quality Standards

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Private Well Laws and Rules

- Water quality not regulated
- Water quantity not regulated
- Well drilling laws We 100-1000
- Notification laws. See handout
 - “Problems”
 - Radon

Introduction to NH Private Well Strategy

- This is an outreach program to people with private wells.

Private Well Strategy

- Developed in approximately 2000.
- Concerned with the health risk from common health based contaminants in NH private wells.
- Internal study conducted by the Public Drinking Water program.
- Produced a multifaceted outreach program directed to residents of NH.
- Recognized much more geological risk, than from manmade contaminants.

Components of The Strategy

- Educational based program
 - Focused on real estate sales.
 - Developed partners with professions in the real estate industry.
- Testing Private Wells. Two Goals:
 - Adequate frequency of testing.
 - Comprehensive list of frequently seen health parameters.

Components of Strategy

- Radio spots.
- Private well trifold handouts.
- Added “private well sidebars” to media stories addressing Public Water System contaminants.
- Lectures to citizen groups.
- Assistance from those in the real estate industry.
- Suggestions to towns concerning comprehensive water quality list for a Certificate of Occupancy (CO).

Strategy Future

- Educational Outreach effort will continue.
- Peer committee currently reviewing strategy approaches:
 - Educational versus statutory requirement.
 - Testing and notification versus testing and correction.
- If statutory change supported, legislation might be proposed in 2009

A Few Current Problems

- Testing is not specified for rental housing.
 - This is a Health Department Issue
- NH uses the National Plumbing Code 2006.
 - Code requires “potable” water. This requirement is currently not observed by most town COs since there is not a minimum short list of required test parameters.
 - Some contaminants such as arsenic and uranium are normally addressed by point-of-use (POU) size devices. Windham has outlawed POU devices. A staff concern is whether new owners be able to keep up with the cost of future maintenance.

Strategy Problems

- Many towns do not have CO.

Private Well Strategy

List of Water Quality Parameters

- Standard Analysis
- Radionuclides
- VOC
 - Fuels
 - **Solvents**

See www.des.state.nh.us/pdf/well_testing.pdf

Well Types

- Dug Wells
 - Derives water from sand and gravel strata
 - www.des.state.nh.us/ws.htm see 1-4
 - Typical Problems: Construction, corrosive water
- Bedrock wells
 - Derives water from the bedrock fractures
 - www.des.state.nh.us/ws.htm see 1-2
 - Problems: Radionuclide, arsenic, fluoride, hardness,

Sensitivity to Specific Contaminants

• Wells	Bedrock	Dug
• Fluoride	x	
• Gross Alpha	x	
• (Beryllium)	x	
• Arsenic	x	
• Uranium	x	
• Radium 226	x	
• Radium 228	x	
• Bacteria	x	x
• Nitrate	x	x
• Iron/ manganese	x	x
• Corrosion		x

Radionuclide

- Three types of radiation:
 - Alpha Proton – heavy fast particle
 - Beta Electron – light fast particle
 - Gamma Energy wave – very light fast particle
- Alpha does the most damage to cells
 - Alpha stopped by a piece of paper
 - Beta
 - Gamma pass thru the body

Radionuclide Types

- Radium 226 and 228
- Gross alpha
- Uranium
- Radon gas
- Many other rads are not specifically regulated and do not product alpha radiation.

Radium

- Radium 226 = Alpha
 - Radium 228 = Beta
 - Radium 224 = ?
-
- Highest conc. 226 = 42 pCi/L
 - Highest conc. 228 = 8 ?
 - Highest conc. 224 = No data base

Radium

- Health based standard Radium 226/228
- Cost
 - \$85 for each species, thus \$175 for both
 - Not processed by DES lab
 - Radium 226 presence can be estimated by knowing gross alpha and uranium
 - Radium 228 can not be estimated
- Radiums accumulates in the body like calcium

Radon

- Radon comes from the decay of Radium 226.
- It can dissolve into water; or migrate upward as a gas thru the soil.

Thus two different tests are needed to measure radon exposure:

- One for water
- One for airborne radon coming thru the foundation

Radon

- Health based contaminant
- No EPA standard
- State reference level: 2,000 pCi/L
- Highly variable results

Radon Solutions

- Aeration
 - Expensive \$3,500 and up
 - No residual waste to worry about
 - Will make worst iron/manganese
 - Bug screen over outlet
- Activated Carbon
 - Cost \$2,000 plus
 - Carbon replacement every two years or so.
 - Carbon will become an additional source of radiation in your basement.
 - Change out every few years

Distribution of Radon Data

<u>Radon Concentration</u>	<u>Percent Occurrence</u>
• Less than 300 pCi/L	6%
• 300 to 1,000 "	19%
• 1,001 to 2,000 "	20%
• 2,001 to 4,000 "	17%
• 4,001 to 6,000 "	11%
• 6,001 to 10,000 "	8%
Greater than 10,000 "	19%

Radon

- Problems

1. Most people with radon aerators have not tested for Gross Alpha, Uranium or Radium.
2. Aeration devices need a screen over the radon outlet pipe on the roof. Squirrel entry.
3. The air inlet pipe should be in a clean area.
4. Double solenoid to insure stop inflow.
5. Check for air leakage around holes in the radon shell from the aerator. Use cigarette smoke. Ideal design should have the tank under a vacuum.

Radon

- Wells with over 1,000,000 pCi/L
 - Dunbarton
 - Bedford
- Wells over 500,000 pCi/L
 - Hooksett
 -

Uranium

Health based standard

MCL = 30 ug/L

Approximately 7% over MCL

- Highest Water = 5600 ug/L Wakefield
- Second highest = 3600 ug/L Pelham
- Conversion of Units ($\text{pCi/L} \times 1.5 = \text{ug/L}$)
 - Example $20 \text{ pCi/L} \times 1.5 = 30 \text{ ug/L}$
 -

Uranium

- POU Reverse Osmosis is normally sufficient
- For very high values; use whole house anion exchange
- www.des.nh.gov/ws.htm see #3-11
- If poor performance check for pH under 6

Gross Alpha

- Health based standard
- The GA term is used in two ways by EPA:
 - 1. Results of a laboratory test for all alpha radiation except radon.
 - 2. Water Quality MCL for all unnamed contaminants that emit alpha radiation except radon and uranium.
- See www.des.nh.gov/ws.htm see 3-11

Gross Alpha

MCL NA 20 pCi/L (30 ug/L) 15 pCi/L

- Analytical Gross Alpha - Uranium = Compliance Gross Alpha
- AGA - U = CGA
- Example
- Given: Analytical G. alpha = 25pCi/L; Uranium = 15 pCi/L
 - 25 pC/L - 15 pC/L = 10pCi/L*
 - * Violation of MCL
 - **Maximum possible radium 226 = 10 pCi/L

- There are many other radionuclide.
Parameters that we do not test for.

Sodium / Chloride (Salt)

- Of manmade origin
 - Not a health based standard 250 mg/L
- Health concern is the sodium portion
 - Approximate 3-5% of population is on doctor mandated “No sodium regimen”
- Origin of salt
 - Road salt
 - Sodium from salt in treatment devices including sodium
 - Sodium/chloride from waste disposal into dry well+leachfield

Sodium Chloride

- Concerns
 - Injury to leach field, maybe
- Solution
 - Substitute potassium chloride for sodium C.
 - If treating for hardness, reduce the strength of the brine.

Nitrate

- Health based standard
- Nitrate, Nitrite
 - Nitrate MCL = 10 mg/L
 - Nitrite MCL = 1 If high, origin is close in space or time.
- Man caused contamination
- Causes
 - Animal waste piles at farms
 - Fertilization lawns and gardens; excessive application
 - Dense septic systems
- Improvements Reduce man's impact
- www.des.nh.gov/ws.htm see 3-9

Odor

Two Categories

1. Hydrogen sulfide – rotten eggs
2. “More chemical odors”

Odors - H₂S

Hydrogen Sulfide

- Not health based
- Common CO contaminant with Fe/Mn
- www.des.nh.gov/ws.htm see 3-16

Solutions:

Normally add missing oxygen

Aerate or absorb onto activate carbon

Odor- Other

- Other Chemicals
 - Chemical must first be identified
 - Could be any of thousands of modern chemicals
 - www.des.nh.gov/ws.htm see 3-15

Hardness

- Hardness is not a common NH problem
 - Mostly Calcium and Magnesium. Not health based
 - 15% of bedrock wells have elevated levels
 - In dug wells only in Portsmouth and Brentwood areas
 - Leaves “whitish” deposits on surfaces
 - Reduces heat transfer efficiency
 - By building a mineral layer at heat transfer points
 - Required a greater concentration of soap
 - First amount of soap reacts with hardness; the rest cleans
 - Produces “grease” scum when floating on water
 - www.des.nh.gov/ws.htm See 3-16

Hardness Treatment

– Treatment

- Water softening
 - Advantages - simple operations ;
» low cost
 - Disadvantages Waste salt contamination disposal;
» Adds sodium to treated water
- In the future; Membrane separation such as (RO)
- Magnetic Treatment: Questionable effectiveness

– Concentrations

- | • Engineers | Water Treatment Ind. |
|--------------|----------------------|
| • < 75 mg/L | 50 |
| • <150 mg/L | 100 |
| • < 300 mg/L | 150 |
| • | |

Corrosive Water

- Corrosive Water Dissolves Lead (pb) and Copper (cu)
 - pH number less than 7 are acidic
 - pH number above 7 are **basic /alkali**
- Slow reaction; thus Pb and Cu only measurable in **stagnant** flow conditions
 - 6 hour minimum; 1 liter volume

Corrosive water is not a health based standard but can induced high Pb and Cu concentrations

Corrosion

- Corrosion very common problem with dug wells
 - and surface water source from acid rain
- Solutions;
 - 1. Change the water's chemistry to be non corrosive
 - 2. Separate the water from the pipe wall

Corrosion Treatment

- Add Chemicals to Neutralize
 - Limestone chips in a tank – “contact neutralization”
 - Chemical feed pump energized by the well pump electric circuit
- Create a Separating Surface
 - Phosphate and silica form surface coating layers. Keep water away from metal.

Corrosive water

- Blue-green staining below drip points and in shower stalls. Water needs treatment.
- Blue-green staining on OUTSIDE of plumbing with no leaks is caused by other factors.

Iron/Manganese

- Minerals Iron/manganese (Fe/Mn) can dissolve into water
- Dissolve Fe/Mn is colorless; called ferrous, manganous
- Precipitated Fe/Mn is rusty brown; called ferric, manganic
- NH State base health standard for manganese at 0.84 mg/L but no health standard for iron.
- Fe/Mn can often co occur with rotten egg odor

Fe/Mn Solutions

- Use whole house treatment since rusty brown staining shows at all plumbing outlets
- Solutions:
- Water Softening – salt
 - All chemicals are dissolved (colorless)
 - Any solids will coat over the porous ion exchange resin
 - Adds sodium to water
- **Oxidation / Filtration**
 - Chemicals create a precipitates
 - chlorine, ozone, KmnO_4 , air

Bacterial

- Health Based Standard
- Total coliform is an indicator organism
- When coliform are present, disease organisms may be present.
- When e-coli or fecal coliform are present, disease organisms are much more likely to be present.

Bacterial Solutions

- The presence of total coliform implies:
 - Injury to the filtering soils
 - Poor well configuration
- Check for proper well constructed
- UV (ultraviolet) disinfection
- Hypochlorite disinfection

Fluoride

- Health based standard
- www.des.nh.gov/ws.htm see 3-5
- Low concentrations of Fluoride reduce tooth decay
- High concentrations reduce tooth decay, but cause tooth staining and cause embrittlement of bones.
- Solutions to High Levels:
 - Point-of-use activated alumina or
 - Reverse Osmosis.

VOC Contaminants

- All health based standards
- www.des.nh.gov/ws.htm see 3-10

Relative few occurrences in NH
State program to fund fuel cleanup

Treatment:

Aeration – For heavy contamination

Activated Carbon – For polishing and small
concentrations

Arsenic

- Health based standard. MCL = 10 ppb
- Two species of arsenic: Valance 3 and 5
- www.des.nh.gov/ws.htm see 3-2
- Field test to speciate Arsenic
 - Using pilot - anion exchange resin
 - Identifies Phosphates
 - Identifies Silica
 - Two arsenic tests to identify species

Arsenic

- **Solutions**
- Arsenic attraction to Iron
 - Many proprietary absorbent products, activated alumina
 - Most products less efficient for arsenic 3
 - And less efficient for higher pH values.
- Also anion exchange / corrosion concern
- **Waste**
- Arsenic locked into many proprietary medias.
 - Deemed not hazardous
 - These medias can be landfilled.